Smart Eye Tracking System

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ABSTRACT

Disabled people are not able to move independently,especially patients with quadriplegia do not have ability to control their muscular tissues omitting the head and eyes.So this paper introduces a smart eye tracking system,which contains four modules-image processing module,wheelchair controlling module,sms managing module and appliances controlling module. The image processing module contains a camera which uses a python customized image processing technique.The movement of eyes is captured via webcam,for further processing, the captured image is send to raspberry pi.Opencv platform is used for finding the geometry of the eye ball.This geometry of eye ball is used as cursor for controlling the screen of raspberry pi.The wheel chair controlling module contains two servo motors,that can be moved in two dimensions.Along with wheel chair it also control electric appliances like fan,light etc and also sms manager module is used to send messages to the care taker.This system reduces the complexity compared to the joy stick control system.

IndexTerms-Wheelchairs,Raspberrypi,Python,Opencv,Image processing,Disabilities ,Elderly people

I. INTRODUCTION

Day by day, there are different types of intelligent systems , that are introduced with the improvement in technology. Everything is more intelligible and stylish, so many researches are made to develop an electric wheelchair for the disabled people in order to improve their quality of life**,** such as brain-controlled wheelchair and voice-controlledwheelchair. Inbrain-controlled wheel chair, the brain signal is taken by placing electrode cap on the user's scalp, then this signal is translated into movements, but it has many disadvantages such as,requires more time for system setup, needs high budget, response is slow etc.

In voice based wheelchair, users gives voice commands to move the wheelchair but it has many disadvantages like gives slow response to noisy environment that can lead the system to respond incorrectly.

So, these drawbacks made us to develop a prototype called smart eye tracking system, which will remove all these drawbacks and it is very helpful for disabled people in order to enhance their quality of life effectively. The main theme of this project is to develop a model of smart eye tracking system which can control the electricwheelchair, appliances and send messages to caretaker by sending messages to smart phone.

This system comprises of four modules such as image processing module, wheelchair controlling module, appliances controlling module and SMS managing module.

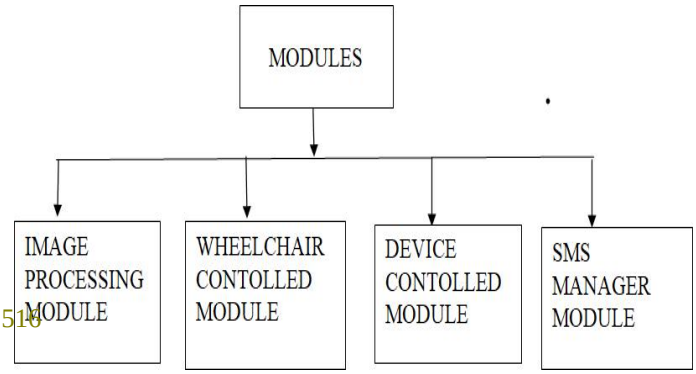


IMAGE PROCESSING MODULE

The main module of this system is image processing module,starts with webcam to capture the eye images and then given to raspberry pi for image processing ,in order to find the geometry of eye ball.

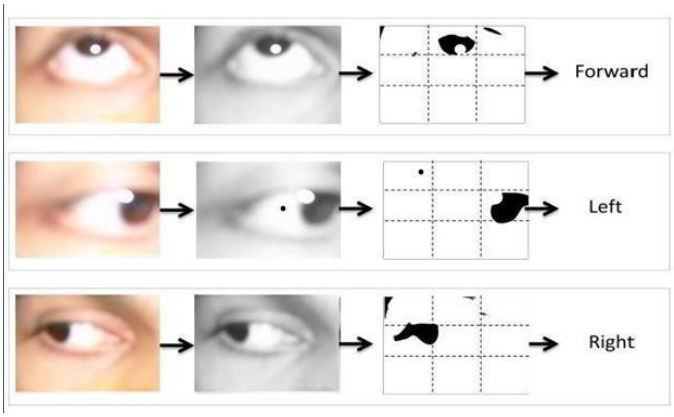


Fig.1 Image processing module

Image thresholding and image filtering concepts are used for processing the eye ball movement to get the correct pictorial idea of eye ball

WHEELCHAIR CONTROLLED MODULE

Servo motors are connected to the wheelchair helps in movement of desired direction of the disabled person through L293D motor driver. This motor driver uses two pins referred to as inputs to sense the desired direction of the output, and another pin called Enable to sense on/off

DEVICE CONTROLLED MODULE

In device-controlledmodule, it controls the appliances like fan, light using raspberry pi and relay module under the control of eye ball movement.If the raspberry pi wants to be turned ON, then activation of the relay is done by energizing the coil. Similarly, if the raspberry pi wants to be turned OFF, then relay de-energize the coil by sending a LOWsignal

SMS MANAGER MODULE

This module uses GSM for sending the messages to the care taker in order to monitor the condition of the paralyzed person

II. LITERATURE SURVEY

According to Research paper in 2018 titled as " EEG BASED BRAIN CONTROLLED WHEEL CHAIR ". The main Objective of author was, building a brain computer interface (BCI). EEG signal is taken to control the wheelchair and the signal is moved to the Micro Controller for Movement in the Wheel Chair. And the Brain or EEG signals are detected by placing the metal electrodes on the surface of the brain. The main drawback of this system is that it has less response and requires a lot of time to setup the system and the implementation of this system is much expensive.

According to Research paper in 2018 titled as " AUTOMATIC VOICE CONTROLLED WHEEL CHAIR"Inthis paper the main Objective of the author was, building a Voice Controlled Wheel Chair for the people with physical disability. The voice-controlled wheelchair system is operate by using the voice commands through the given input from the disabled person. And this voice-controlled wheelchair system consists of motor system, voice recognition and obstacle detection system and it is done by using ultrasonic sensors in order to brake or stop the developed wheelchair immediately whenever any obstacles are suddenly come in the way of wheelchair. The main drawback of this system is low immune to noisy environment which will results in system to respondincorrect.

According to the Research paper in 2018 titled as "EYE GAZE CONTROLLED WHEELCHAIR".In this paper the main objective was to develop a wheelchair which moves based on the eye movement.In this camera used to capture the eye ball movement.The images are transferred to raspberry pi microcontroller.In this system the blinking of eye is regarded as enter button and servo motors are used for the motion of wheelchair.In this sensors are used to detect any obstacles in the moving direction.But the main drawback of this system is the object detection time is more,and also the paralysed person the will not acces the electrical appliances like fan,light. and doesnot send sms to the care in case of emergency

III. SYSTEM ARCHITECTURE

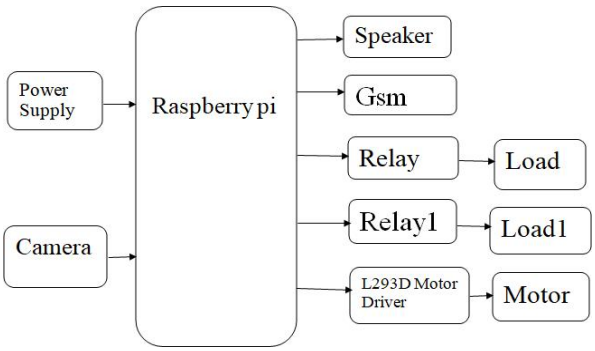


Fig.2:Block Diagram

POWER SUPPLY

Power supply is a source of electrical power.A power supply unit is a component which provides electrical energy to an output load. 5v is recommended power supply for raspberry pi .Power supplies are two types.Linear and Switching.In linear power supply ,input voltage is given to transformer and then it is rectified to obtain DC voltge.In switching power supply input voltage is directly rectified to obtain the dc voltage

CAMERA

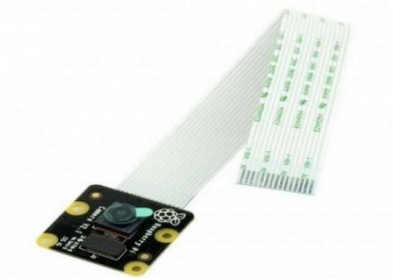


Fig.3:NoIR Camera v2

NoIR Camera v2 is the authority night vision camera board delivered by the Raspberry Pi Foundation which associates with any Raspberry Pi or Compute Module. NoIR Camera Module v2 is an excellent 8-megapixel camera based around the Sony IMX219 picture sensor permitting you to make HD video despite everything photos.It is equipped for 3280 x 2464-pixel static pictures, and furthermore upholds 1080p30,720p60 and 640x480p90 video. The NoIR camera has No InfraRed channel on the focal point which makes it ideal for doing infrared photography and taking pictures in low light conditions, and for photography and video in obscurity

RASPBERRY PI

Raspberry pi is a Quad center processor. It has 40 universally useful info/yield hot chicks' ports, LAN port, a miniature SD card opening, a DSI show port, a miniature USB power input, a composite video and sound result jack, a CSI camera port, and a HDMI video yield. It contains everything expected to help the chip and it associate with PC in which Raspbian OS is introduced and power it with a connector. Raspberry pi is a microchip board, is a 64bit ARMv7.The quad-center raspberry Pi 3 is both quicker and more fit than its ancestor, the Raspberry Pi 2. Furthermore it doesn't have an on board WIFI, Bluetooth and USB boot capacities. Along these lines, the Pi 3 is generally half quicker than every former board.

The working framework for all Raspberry Pi items is Linux. Linux is an open-source working framework that points of interaction between the PC's equipment and programming programs. The language utilized with Raspberry Pi is Python - a broadly useful and significant level programming language used to foster graphical UI (GUI) applications, sites, and web applications. One of the advantages of Raspberry Pi is that it isn't important to have a close information on Linux or Python prior to starting an undertaking with Raspberry Pi. Truth be told, the motivation behind the item is to show the framework and language through drawing in projects. The most fundamental model is the Raspberry Pi Zero or Raspberry Pi Zero W - the Zero W accompanies Wi-Fi and Bluetooth capacities while the Zero doesn't. The fundamental model gives the client the chance to get familiar with the coding and investigate the Internet of Things (IoT) with projects intended to keep the student locked in. The IoT is a framework that comprises of interrelated figuring gadgets and mechanical and computerized machines giving the capacity to move information over an organization. Utilizing Raspberry Pi Zero, you can embrace activities, for example, word clocks, ecological screens (temperature, stickiness, and so on), airplay speakers, educational showcases, drones, retro games, and selfie bots.

Fig.4 Raspberry pi 3 model b+

RELAY

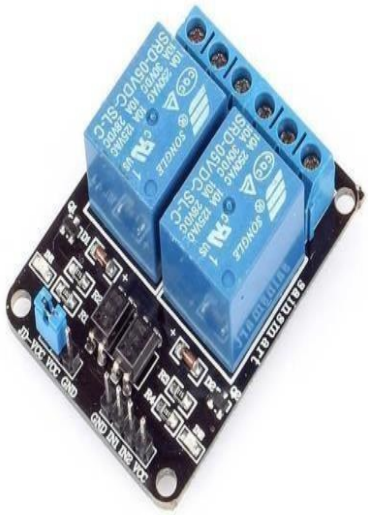


Fig.5 Relay Switch Board

A Relay is an electrical switch that opens and closes heavily influenced by another electrical circuit. In the first structure, the switch is worked by an electromagnet to open or close one or many arrangement of contacts. A Relay can handle a result circuit of higher power than the info circuit, it very well may be viewed as, from an expansive perspective, a type of an electrical speaker. Transfers are generally SPDT (single post twofold through switch) or DPDT (twofold shaft twofold through switch) however they can have a lot more arrangements of switch contacts.

GSM

Worldwide System for Mobile correspondence is a cell organization, and that implies that cell phones interface with it via looking for cells in the quick area. GSM networks works in four different recurrence ranges. Most GSM networks work in the 900MHz or 1800MHz groups. GSM-900 utilizations 890-915 MHz to send data from the portable station to the base station(uplink) and 935-960 MHz for the other direction(downlink), giving 124 RF channels put separated at 200kHz.GSM likewise spearheaded a minimal expense, to the organization transporter, choice to voice calls, the short message administration, which is presently upheld on other versatile norms also. Another benefit is that standard incorporate one overall Emergency phone number, 112.This makes simpler for worldwide voyagers to interface with crisis administrations without realizing the nearby crisis number.

DC MOTOR

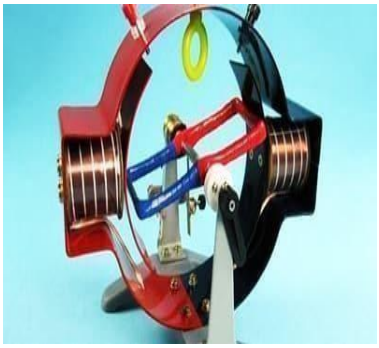


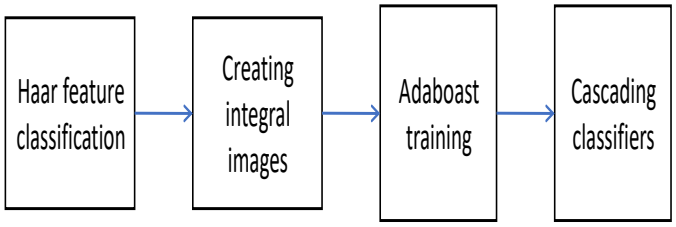
Fig.6 Dc Motor

A DC engine is an electrical machine that changes over electrical energy into mechanical energy. The DC engine working guideline is the point at which a current conveying guide is set in an attractive power, power is applied. The way of the mechanical power is known by Fleming's Left-hand Rule and its greatness is given by F=BIL Newton. For applications, for example, in still plants, mines, and electric trains, it is benefits to change over exchanging flow into direct flow to utilize dc engines. DC engine is famous as three-stage acceptance engines

IV. IMPLEMENTATION & WORKING

Haar cascade algorithm

Haar cascade algorithm is a machine learning object detection program that is used to identifies the objects in an image and video. And this haar cascade classifier consists of four stages they are Haar feature Selection,Creating integral images , Adaboost training and Cascading classifiers for face detection.



This algorithm requires a lot of positive and negative images in order to train the classifier.Haar features are very usefull image features used in object detection.

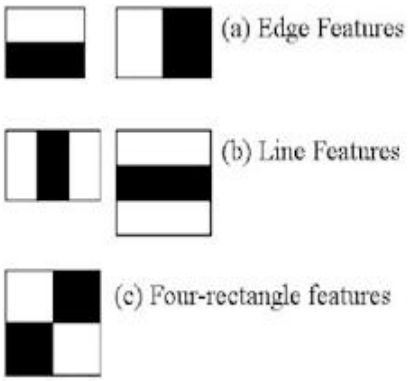


Fig.7 Haar cascade algorithm features

Each feature is a single value obtained by subtracting sum of pixels under the white rectangle from sum of pixels under the black rectangle. An Integral Image is an intermediate representation of an image where the value for location (x, y) on the integral image equals the sum of the pixels above and to the left (inclusive) of the (x, y) location on the original image.The integral image of the pixel in the sum of the pixels above and to the left of the pixel.Redundant features are removed by adaboast ,only relevant features are choosen.The classifiers are trained by using adaboast and adjusting the threshold to minimize the false rate.

Circular Hough transform

The circular Hough transform is used to detect the circle,Hough gradient method is used to find the edge of the circle,in each pixel on the edge of this circle will be created other circle so the position that have the most pixel accumulation from this center creation is center of circle which would like to detect.As shape of the eye ball is circle,hence we are using this algorithm to detect the eye ball.

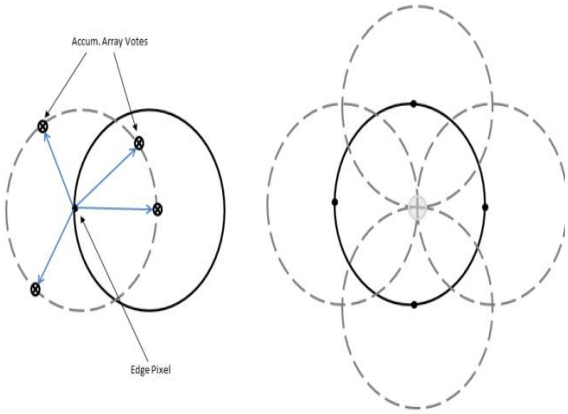


Fig.8 Circle hough transform algorithm

Flow Chart

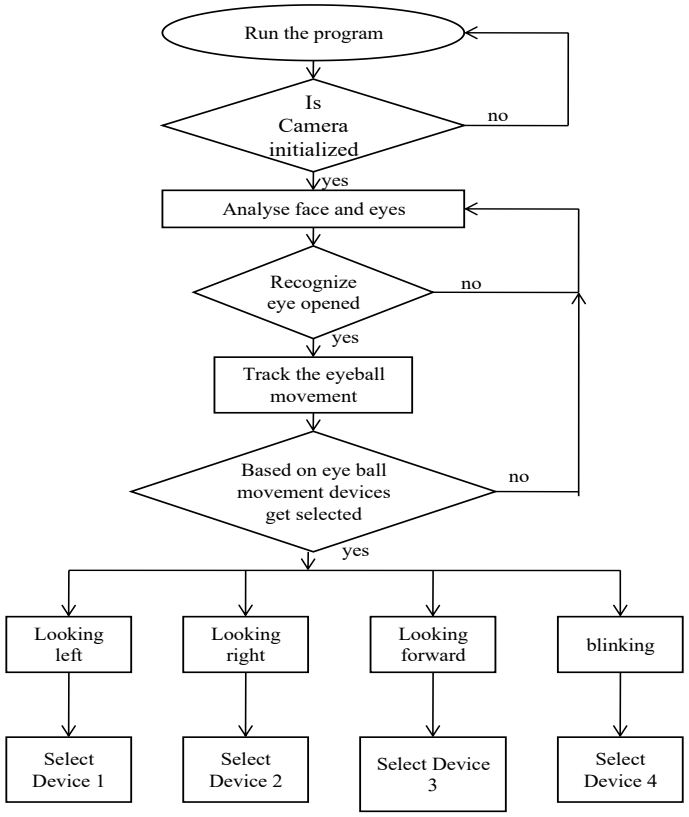


Fig.9 Flow chart of Smart Eye Tracking System

Webcam is used for capturing the images.Haar cascade algorithm is used to detect ,face and eye.It is one of the important algorithm, built in Opencv.Eye ball movement can be detected by using hough circle algorithm and some image processing techniques are used.Hough circle algorithm is used for detecting the circles,where the shape of eyeball is circle,hence we use this algortihm for better response.This algorithm crop the eye region and it will draw the circles on that particular region to detect eye ball .A corner detection algorithm is used in order to find the corner of the eye ball.Averaging of these points gives the center point.Minimum distance says eye pupil is in left direction.Maximum distance says eye pupil is in right direction.No movement of eye indicates eye pupil in middle postion.When the eye ball moves left ,then device 1 called light will get selected,based on that movement light gets ON

or OFF.When the eye ball moves right,then device 2 called fan, gets selected.based on that movement fan gets ON or OFF,for blinking ,device 4 gets selected,where device 4 called sms module will get selected,based on that movement sms is sent to care taker.where devic 3 is wheelchair module,when the eye ball position is middle then the wheelchair moves in forward direction,when the eye ball movement is left then wheelchair moves in left direction ,similarly for right ,wheelchair moves in right direction.eye blinking is used for start and stop operation.

V. RESULTS

Case 1: Based on eye ball movement turning ON the lamp.

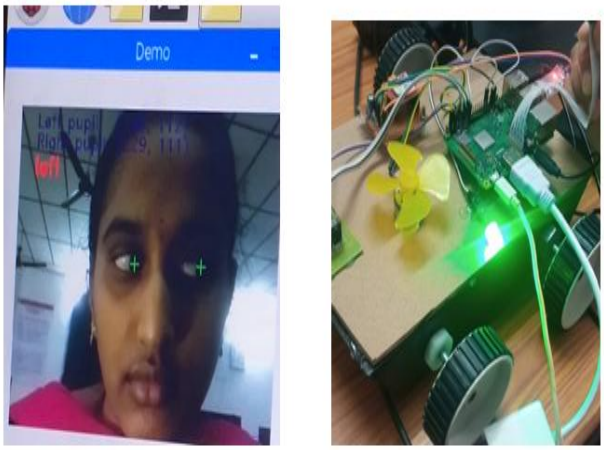


Fig.10 Output when the eyeball moves left.

Case 2: Based on eye ball movement fan rotates

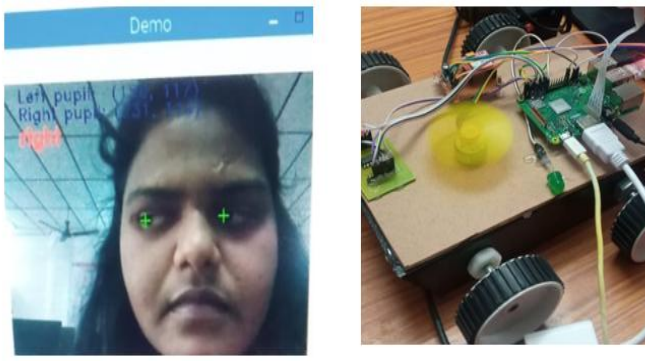


Fig.11 Output when the eyeball moves right

Case 3:sms sent to the caretaker.

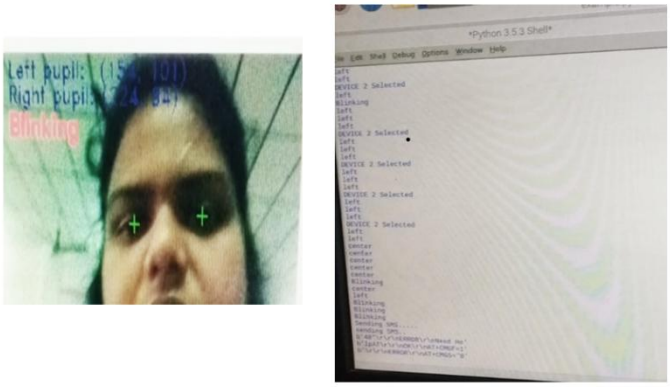


Fig.12 Output when eye blinks.

Case 4:based on movements of eye ball,wheel chair gets controlled

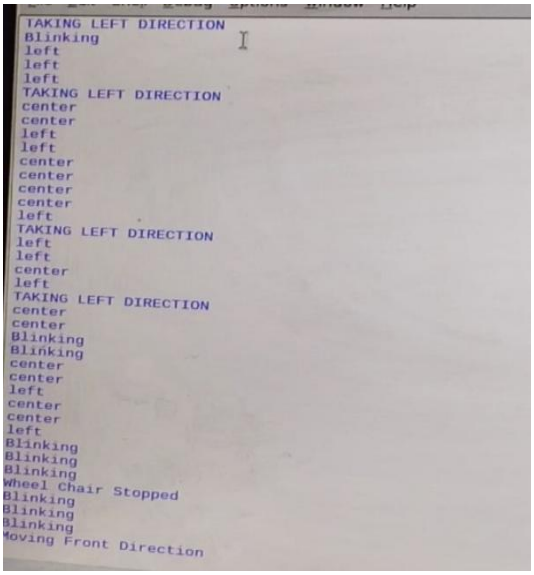


Fig.13 Output of wheel chair controlled module.

VI. CONCLUSION

This system is completely based on the eye movement, consists of four modules. Presence of each and every module has been reasoned out and positioned cautiously hence it will help for the best working of the system.Here the system is operated automatically. The thought of eye control has great use not only for the future in out but more importantly to the handicapped and disabled people.One of the main goal of eye tracking system is to make the life of paralyzed people simple and easy in this system the wheel chair moves automatically without anyone's support and the paralyzed people can control the appliances like fan and light by using eye movement and send sms to the care taker.

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